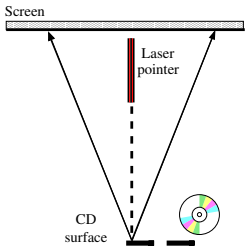
Experimental challenge*: **Grooving on the waves**

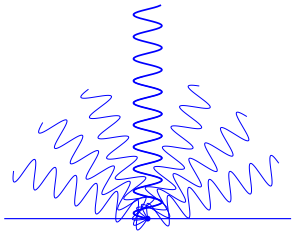
Simple waves Deadline: 7/March/2018

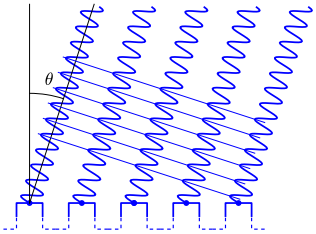
Experimental part

You have to point a laser (a laser pen for presentations does the job) perpendicularly to the reflecting surface of a CD (with a DVD or Blue-ray the result is not the same). In principle it seems that the reflected ray approximately comes back to the laser pen but putting a screen (a white paper paper on a box) we observe bright spots apparently corresponding to rays reflected in weird directions.



Scheme of the experiment


Huygens principle



Bright direction

Huygens principle asserts that when a wave reach a point, it becomes a source of waves in every direction (second figure). What we see in reflection is an interference of these waves. The groove of the CD separates in some way the influence of the plateaus and pits giving unexpected reflection directions.

Mathematical part

Assume a naive form of the Huygens principle consisting in that when the sine waves from the laser pointer reach the mean point of each plateau then new sine waves come out along each direction. In some directions, like the angle θ in the third figure, the interference is constructive, the waves are perfectly parallel with maxima on the same line, and we see a bright spot.

Under this model, find an equation for the bright directions involving the frequency of the laser light and the separation d between the plateaus. The frequency is normally indicated on the laser pointers. Use the experiment and the equation to derive numerically the value of d. If you see several bright points on your screen, check the formula and the calculated value of d with the next one.

*Some experiments are classical, some are my idea and others come from specific sources. In the latter case I have omitted the reference here on purpose to force the students to work on their own. If you are the author, please do not get angry. I intend to incorporate the references to the final version of the notes.